A new typewriter training system

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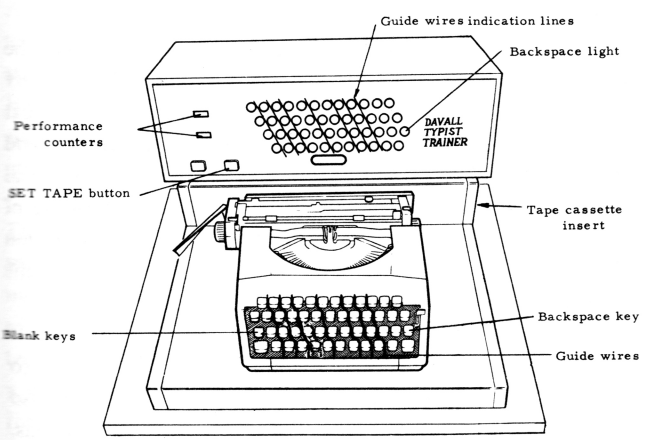
Since the advent of the teaching machine, some ten years ago, several attempts have been made to mechanize the instruction of typing and typesetting skills. At one extreme, there have been simple visual aids to help beginners locate the 'home' keys, and to indicate which finger should press which key. At the other extreme, there have been elaborate adaptive teaching systems which provide visual cues for locating the next key to be pressed, and tactile cues (vibrators fitted to the home keys) to designate the finger that should do the pressing. Neither of these two extremes has survived, commercially. The simplest devices do not give enough assistance, and the most complex devices, with their elaborately graded programs and adjustable pacing functions, are too expensive.

The device shown in the illustration is the Davall typist trainer, and it appears to be a near-optimal compromise between economic and instructional requirements. It is sufficiently automated and motivating and 'cheat-proof' to instruct students for several hours at a time, without the help of a human supervisor. But several of the more esoteric modes of assistance have been eliminated, with considerable savings in cost.



The trainer

The basic equipment consists of an Imperial Messenger portable typewriter built into an electronic control unit that monitors the trainee's performance, by telling him what to do and by correcting him when he goes wrong. To trainees encountering the equipment for the first time, the device has all the appearance of a 'normal' typewriter, except for three distinctive features. First, all the keys are *blank*. The trainee is therefore discouraged, from the very start, from scanning the keys to see where particular letters are located. Secondly, a set of metal guide wires runs between adjacent banks of keys to facilitate correct positioning of the fingers. These guide wires can be removed as soon as the correct finger habits have been established. Thirdly, and most importantly, there is a large 'information display' located above the typewriter. On the left-hand side of this display, there are counters which record (independently) cumulative totals of correct and incorrect responses that the trainee has made. Across the centre of the display, is an array of 'cue' lights which exactly replicate the spatial lay-out of the typewriter keys.

Each of these cue lights has a letter printed across it, the letters on the display being arranged in the same pattern as the keys on the keyboard. These letters become clearly visible only when they are lit up, and they are illuminated one at a time by a punched-tape program contained in a special tape cassette. In the simplest mode of operation, the letter that is illuminated is always the one that has to be typed next, and the position of the illuminated letter corresponds with the position of the key that should be pressed. For example, the cue light on the extreme right of the visual display is labelled with a red 'backspace' symbol—and corresponds with the position of the actual backspace key on the extreme right of the keyboard. When this particular symbol lights up, it usually means that the trainee has made a mistake, and is being required to go back a space to retype the previous letter correctly. Before going into these complications, however, it is desirable to be clear about the overall method of instruction used.

Instruction

Stage 1

When a trainee first attends for instruction, there are several preliminary routines that she has to be taught. First, she must learn the correct *posture* to adopt when typing—how to adjust the height of her chair and to position her elbows and forearms etc. Secondly, she must familiarise herself with the basic *manipulanda* of typewriting machines. For example, she must know how to insert headed notepaper into the typewriter, by holding it upside down and back to front and by manipulating the paper-release lever, the roller, and the paper bail. She must also be able to set margin stops and to operate the space bar, the shift key, the margin-release key, and the backspace key. Finally, she must know how to use the carriage-return lever, and the line-space lever.

After these basic skills have been acquired, there are just a few extra operations to be learned in connection with switching on the machine, and with 'setting' it correctly. In practice, it rarely takes more than 15-30 minutes to come to grips with all these

essentials. At present, they are being taught by a human instructor. But a well-illustrated programmed text is being devised to enable the trainee to acquire them with only minimal human assistance.

Stage 2

As soon as the preliminary routines have been learned, the trainee is required to insert a fresh piece of paper into the typewriter, to position it in a particular way (with the margin stops set at 10 and 80), and to swing the carriage as far to the right as possible in readiness for typing the first exercise line. The machine is then switched on and 'set'. The switching on operation consists in flicking a single switch, and checking that the performance counters automatically return to zero—ready for a fresh count of correct and incorrect responses. The 'setting' operation involves pressing a 'set tape' button on the left of the display, and holding it down for a few seconds until the punched tape has wound on to the end of a line. On releasing the button, a symbol lights up in the visual display. This is the first symbol of a new exercise line. The trainee must locate the key corresponding to the symbol illuminated, and must press it.

If the trainee presses the correct key, the lighted symbol goes out, and another one comes on in its place. This indicates the next key to be pressed. And so on. All illuminated symbols stand for small (lower case) letters unless they are accompanied by the *additional* illumination of the 'shift' key symbol. In this case, a capital (upper case) letter is required, so the trainee must press the shift key first. If the trainee makes a mistake at any point, the symbol that was illuminated stays on. In addition, a buzzer sounds and the red backspace symbol lights up. The trainee must then press the backspace key (whereupon the backspace symbol goes out and the buzzer stops), and must type the original symbol correctly. On doing this, the carriage advances, the next symbol appears, and the exercise continues as before. If the trainee tries to correct a mistake *without* backspacing, the buzzer sounds again, the carriage advances a further step, and the original symbol and backspace lights stay lit. The trainee has then clocked up two errors, and must go back *two* spaces to correct her mistake. Altogether, the machine is able to remember four consecutive mistakes. In practice, this usually suffices to ensure that the trainee always corrects her errors, by backspacing and overtyping, before going on to the next letter.

At first glance, the policy of always correcting errors by backspacing and overtyping may look rather suspect. But experience shows that this particular drill, which rapidly becomes irksome, gives the trainee a strong initial bias towards accuracy rather than speed. In other words, it induces her to learn exactly where the keys are located.

Throughout stage 2, which lasts two to three hours, the trainee is typing directly from the symbols illuminated in the visual display. And the whole operation is entirely self-paced. Although the trainee is encouraged to go as quickly as possible, each symbol will remain patiently illuminated for as long as it takes the trainee to make a response. To simplify matters still further, the initial exercises are mostly of an elementary 'alphabetical' kind (to rehearse particular finger movements and combinations of finger movements), and the guide wires are kept in position to encourage correct fingering. In addition, lines can be drawn across the visual display, corresponding to the positions of the guide wires on the keyboard. And it is even possible to give certain keys (f and j, for example) a distinctive 'feel' by placing bits of putty on them. To ensure that errors are detected immediately, there is the already-mentioned 'mistake' buzzer which tells the trainee to backspace and try again.

Stage 3

After the first two to three hours, the trainer is put into a completey different mode of operation. Instead of requiring the trainee to type directly from the visual display, it requires her to type from the printed copy placed beside the machine. In this case, the punched tape runs in synchrony with the printed copy (it illuminates symbols in the same order as the copy, *but with a delay of up to 5 seconds).*

Suppose, for example, that the printed copy starts with the sentence: The quick brown fox jumps over the lazy dog. Five seconds after the trainee has typed the first letter (a capital T), the visual display will illuminate the next letter 'h'. It will then wait until the trainee has typed the letter 'h' from her printed copy and, 5 seconds later, it will illuminate the next letter 'e'. By introducing this five second delay, the trainee is given the chance to 'beat the clock'—to type 'h' and 'e' (and all the subsequent letters, for that matter) *before* they light up in the visual display. On the other hand, if the trainee manages to run on ahead and then forgets where the letter 'z' (say) is located, the display will catch her up, show her where the letter 'z' is to be found, and will wait for her to press it.

In effect then, each response that the trainee makes has the effect (providing it is correct) of advancing the punched tape by one step—so it is always 'threatening' to illuminate the next letter, five seconds later. If the trainee is sufficiently fast and accurate, she will always be able to beat the lights, so the visual display will not be activated at all. This is a desirable state of affairs, because it is difficult for the trainee to divide her attention between a printed copy to one side of the typewriter and the visual display located above it.

There is, however, one important embellishment. In addition to having a fixed time delay of five seconds, the Trainer can also *vary* the delay interval, by reducing it to as little as two seconds, the faster the trainee goes. More precisely, the machine computes the average response rate that the trainee has achieved over her five previous responses, and uses this to determine the magnitude of the delay interval. If the trainee has been responding more frequently than once in five seconds, the delay interval is reduced to whatever her improved rate is. In this way an attempt is made to 'hold' her at her most recent average rate, whenever this exceeds the comparatively low rate of one response per five seconds.

In order to convey all this to the trainee, a 'pacing light' is placed at the top of the copy from which she is typing. The light comes *on* immediately a correct key is struck, and it stays on until the

delay period expires—whereupon the cue light comes on and the pacing light goes out. If the trainee is sufficiently fast and accurate, the delay period never does expire. So the pacing light remains on, and the cue lights remain off. The trainee's objective, then, is to keep the pacing light on all the time. And the faster she goes, the more difficult this becomes.

As a result of this procedure, the interaction between the trainee and the machine becomes much more dynamic and motivating. In effect, the trainee is caught up in a sort of donkey and carrot race. The faster she goes, the more the machine demands of her. But if she starts making mistakes, the machine helps her out by extending its time allowance.

Experimental results

Teaching machines for instructing keyboard skills have been in existence for about ten years. The earliest were designed to teach card-punching and ad-listing by Lewis, and prototype typewriter trainers were developed soon afterwards. There is a large amount of practical evidence and supporting theory, particularly from the field of control-engineering and cybernetics, to show that these devices, once 'debugged', invariably give dramatic savings in training time. Unlike human teachers, they are infinitely tireless and patient and single-minded. Providing the practice materials are carefully graded and motivating, it is not at all unusual to find these machines reducing training time to less than a third of its traditional duration—and without the help of any human supervision at all. Tests performed on the Davall trainer all support this more general finding. So far, these tests have mostly been of a somewhat informal 'user-oriented' kind. And it is only within the last few months that more rigorous tests have begun on the final production model. The present summary is therefore based on an initial sample of only six girls. But it is worth bearing in mind that their attainments are surprisingly uniform, and are wholly consonant with a mass of informal data collected on earlier prototypes.

The girls were all in the fourteen to fifteen years age range, and were drawn from the B and C streams of a local secondary modern school. None of them had had any previous typing experience, but they all had a desire to learn. And they volunteered to attend for one to two hours per day (two or three times a week) without payment. They were told they could withdraw from the training sessions at any time they pleased, but none of them did so.

From this trial sample, it emerged that the preliminary routines of posture and machine operation took no more than half an hour to impart. After a further two to three hours of practice with simple alphabetical exercises typed directly from the visual display, the guide wires could safely be removed, and the girls could be 'promoted' to typing from printed copy placed alongside the machine (together with the pacing light). Because of the bias towards accuracy, occasioned by the need to backspace and correct every mistake made, errors were down to about 3 per cent (plus or minus 2 per cent) within the first three hours of instruction. After five hours on the Trainer, the error rate was between 1 and 3 per cent of all strokes typed, and the girls were at this stage given two five-minute speed tests. The first of these was to type out a familiar sentence ('the quick brown fox jumps over the lazy dog') over and over again. The second was to type out a piece of prose that they had not seen before.

On the familiar sentence, the girls achieved a rate of 10 ± 2 words per minute, with almost perfect accuracy. On the unfamiliar passage of prose, they achieved 6 ± 1 words per minute at about 98 per cent accuracy. By the time a further three hours had elapsed, these speeds had risen to 18 ± 4 words per minute, and 12 ± 3 words per minute, respectively, and the accuracy was even higher than before. At the time of writing this paper, progress is still continuing at a steady rate, and it looks as if speeds of 30-40 words per minute, on unfamiliar prose and at 99 per cent accuracy, should be achievable within 20-30 hours of training.

There are large savings, of the order of 50 per cent or more on conventional training times. This is achieved under motivating conditions, and with little or no help from a human instructor. There are problems about the design of the instructional materials—in which emphasis is first placed upon the rehearsal of important finger habits, and is later placed upon the rehearsal of *sequences* of letters (eg q followed by u, and t-h-e) which happen to be particularly common in the English language.

There are also problems about the nature and intensity of auditory signals which tell the trainee she is wrong, and about the desirability or otherwise of covering the keyboard with an opaque shield to eliminate, once and for all, the tendency to look at the keys. Perhaps the most novel feature is the machine's insistence that the trainee should assiduously correct every mistake she makes. This feature alone seems to be largely responsible for the high levels of accuracy that trainees achieve in as little as two hours of instruction.

Literature

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